CITY LIGHT 2016 IRP

Stakeholder Presentation

June 2, 2016

THE NATION'S GREENEST UTILITY
SINCE 1905
SEATTLE CITY LIGHT

AGENDA

- Introduction
- Portfolio Analysis
  - Assessing Top Performing Portfolios
    - Deterministic and Stress Testing Analyses
    - Probabilistic Analysis of Top Performing Portfolios
- Summary of Top Performing Portfolios and Draft Action Plan
- Climate Change Analysis
- Wrap up

PORTFOLIO ANALYSIS

Top Performing Portfolios

Deterministic and Stress Testing Analyses

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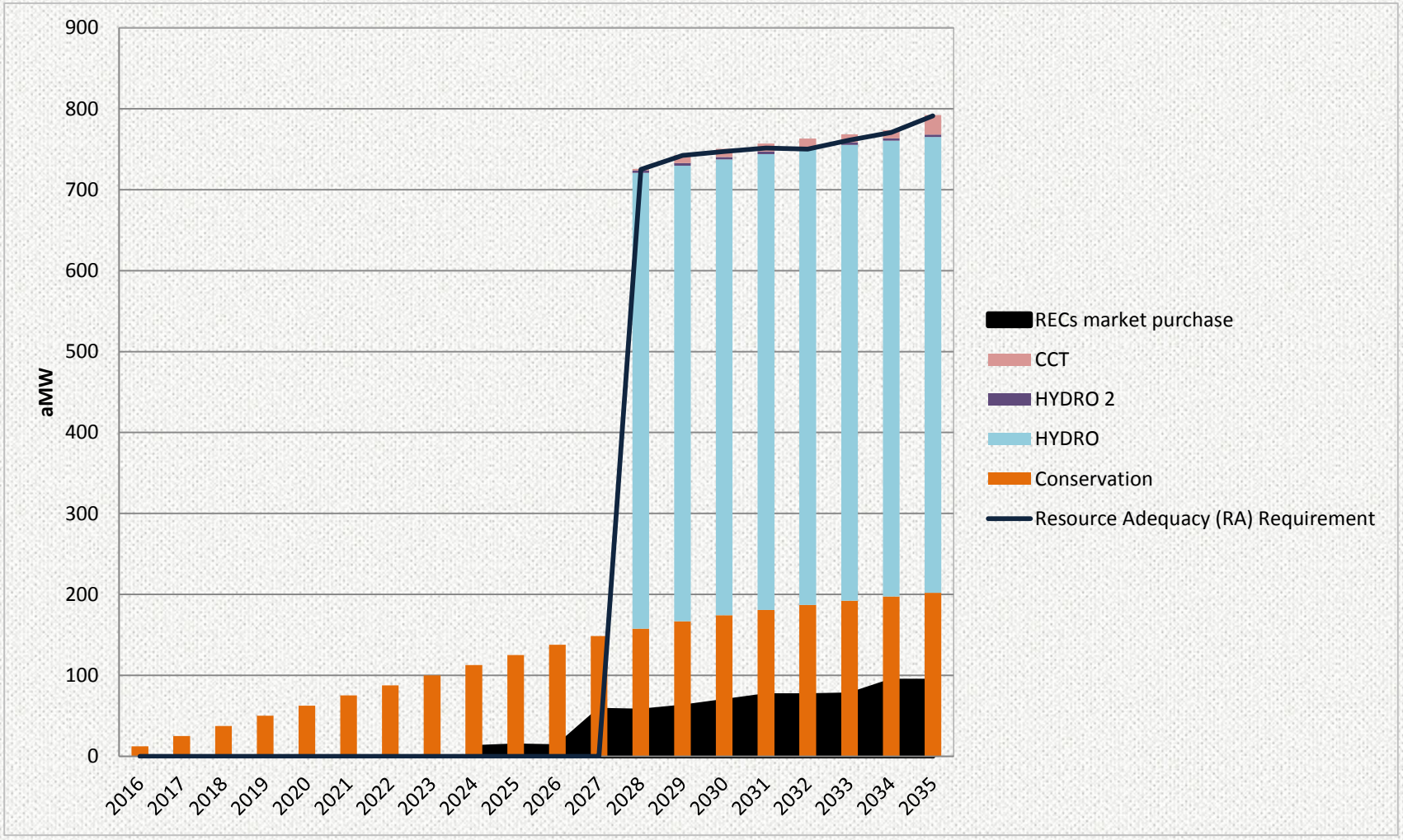
PORTFOLIO OPTIMIZATION MODEL INPUTS & DEVELOPMENT

- Resource Adequacy Requirement
- Renewable Portfolio Standard (RPS) Requirement
- Load Forecast
- Conservation Potential Assessment (CPA)
- Current Resources and Contracts (with expiration dates)
- Renewable Energy Certificate (REC) Inventory

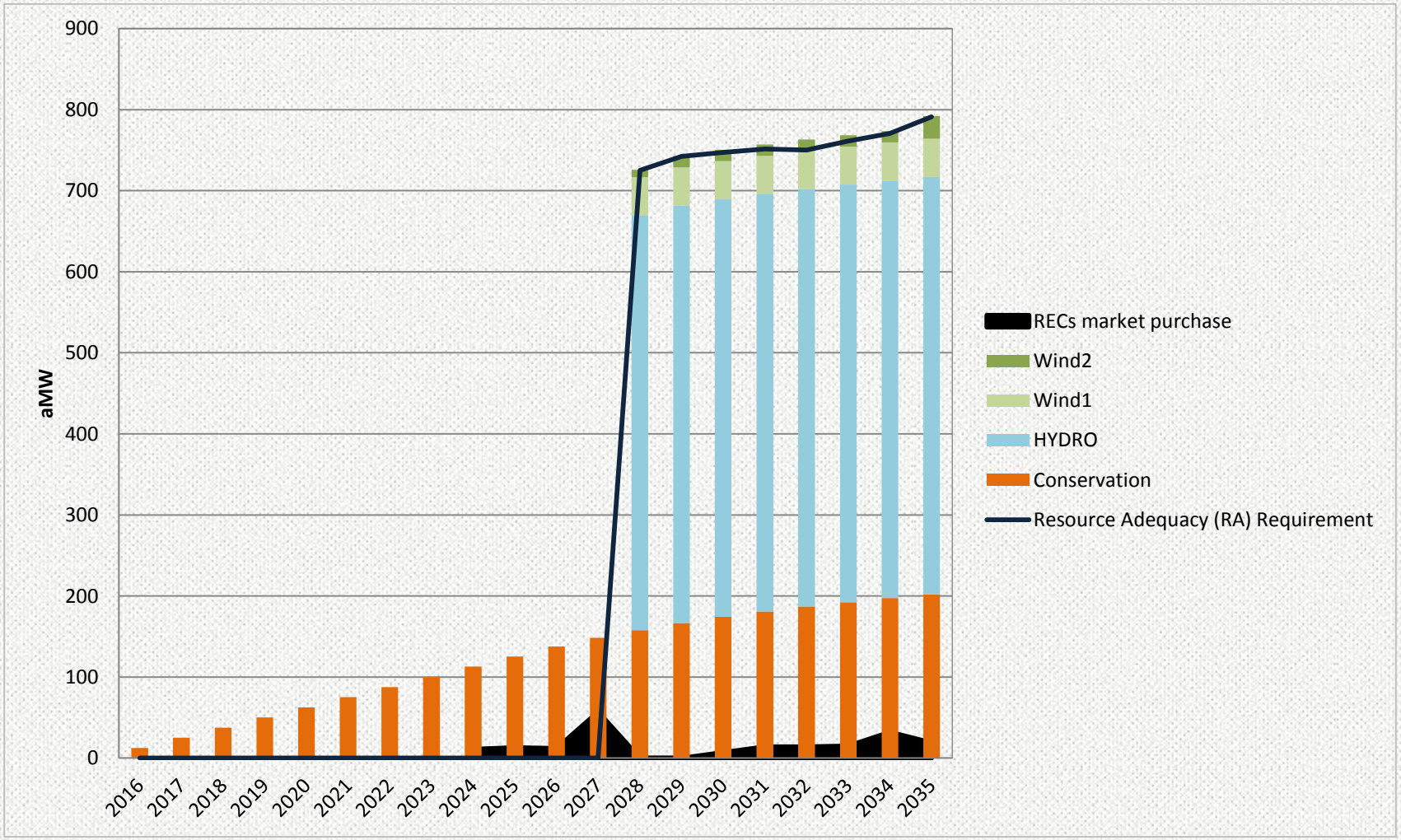
PORTFOLIO OPTIMIZATION MODEL INPUTS & DEVELOPMENT

- Characteristics of Supply Resources:
  - Reliability
    - Availability and Deliverability
  - Cost and Financial Risk
  - Environmental Emissions
- Market Purchase Flexibility
- BPA Contract Expiration in 2028

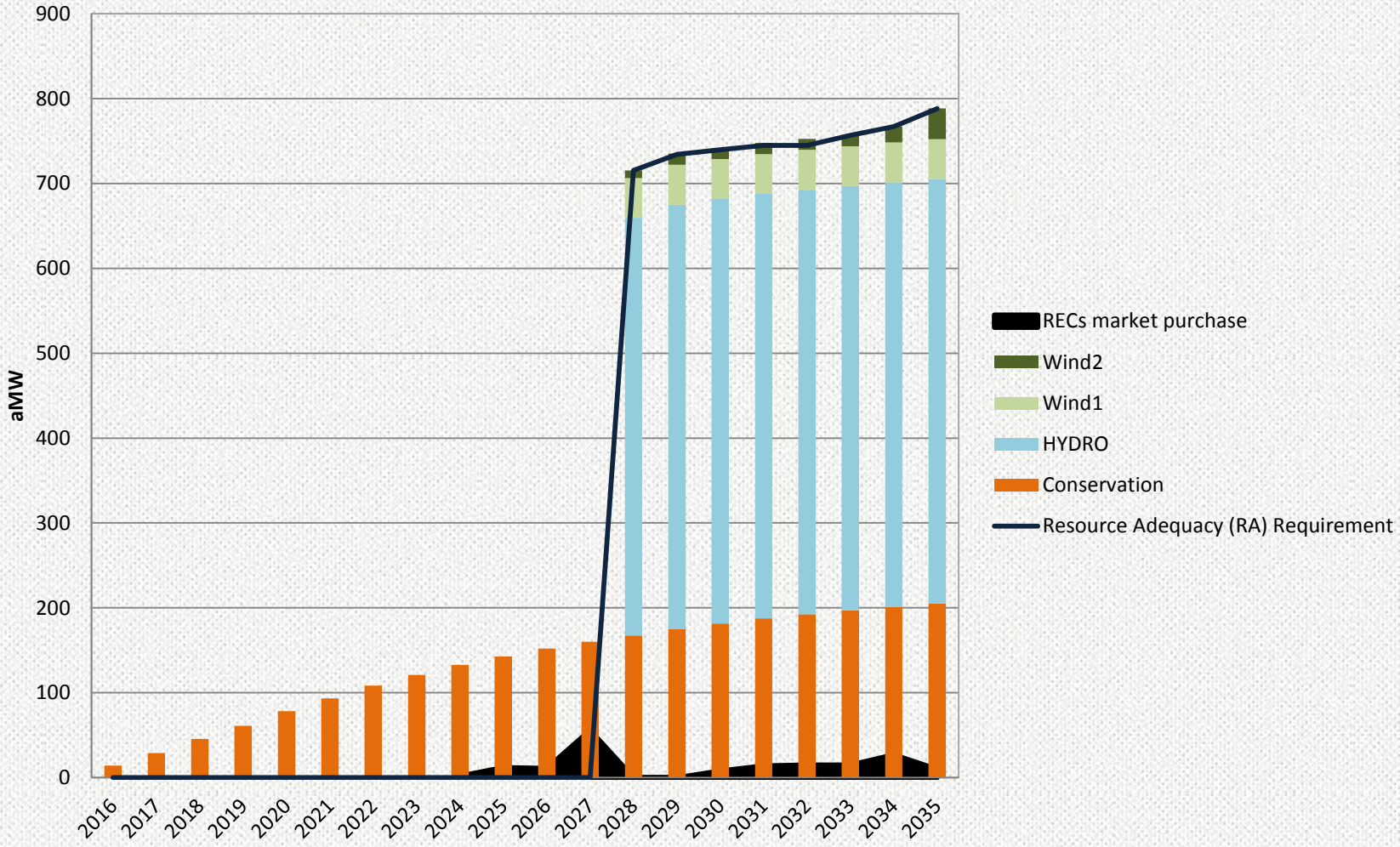
P1: NO RENEWABLES WITH RECS WITH BASE ENERGY EFFICIENCY & 200 MARKET PURCHASE AVAILABILITY



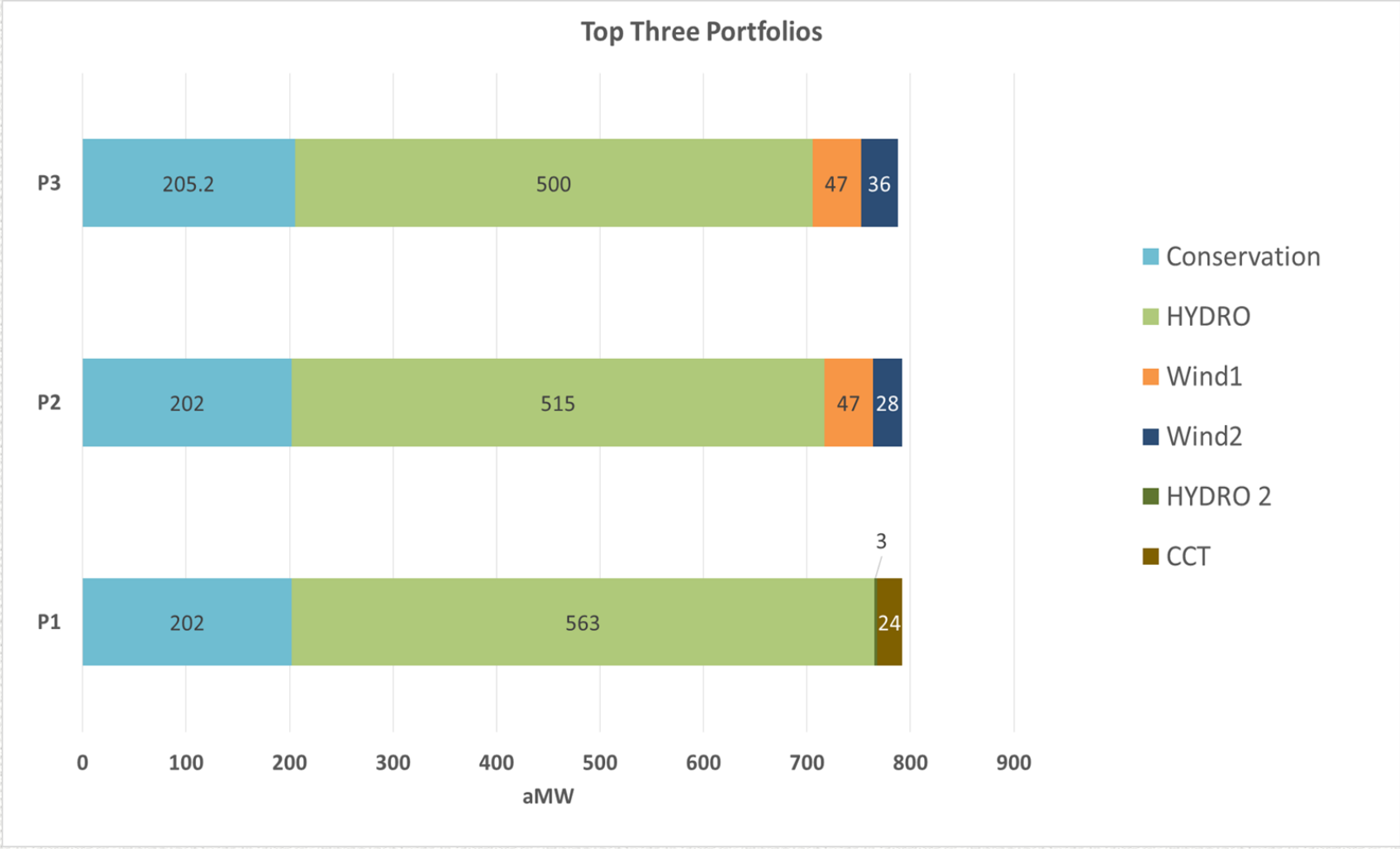
P2: WIND & HYDRO WITH BASE ENERGY EFFICIENCY & 200 MARKET PURCHASE AVAILABILITY



P3: WIND & HYDRO WITH HIGH ACHIEVEMENT ENERGY EFFICIENCY & 200 MARKET PURCHASE AVAILABILITY



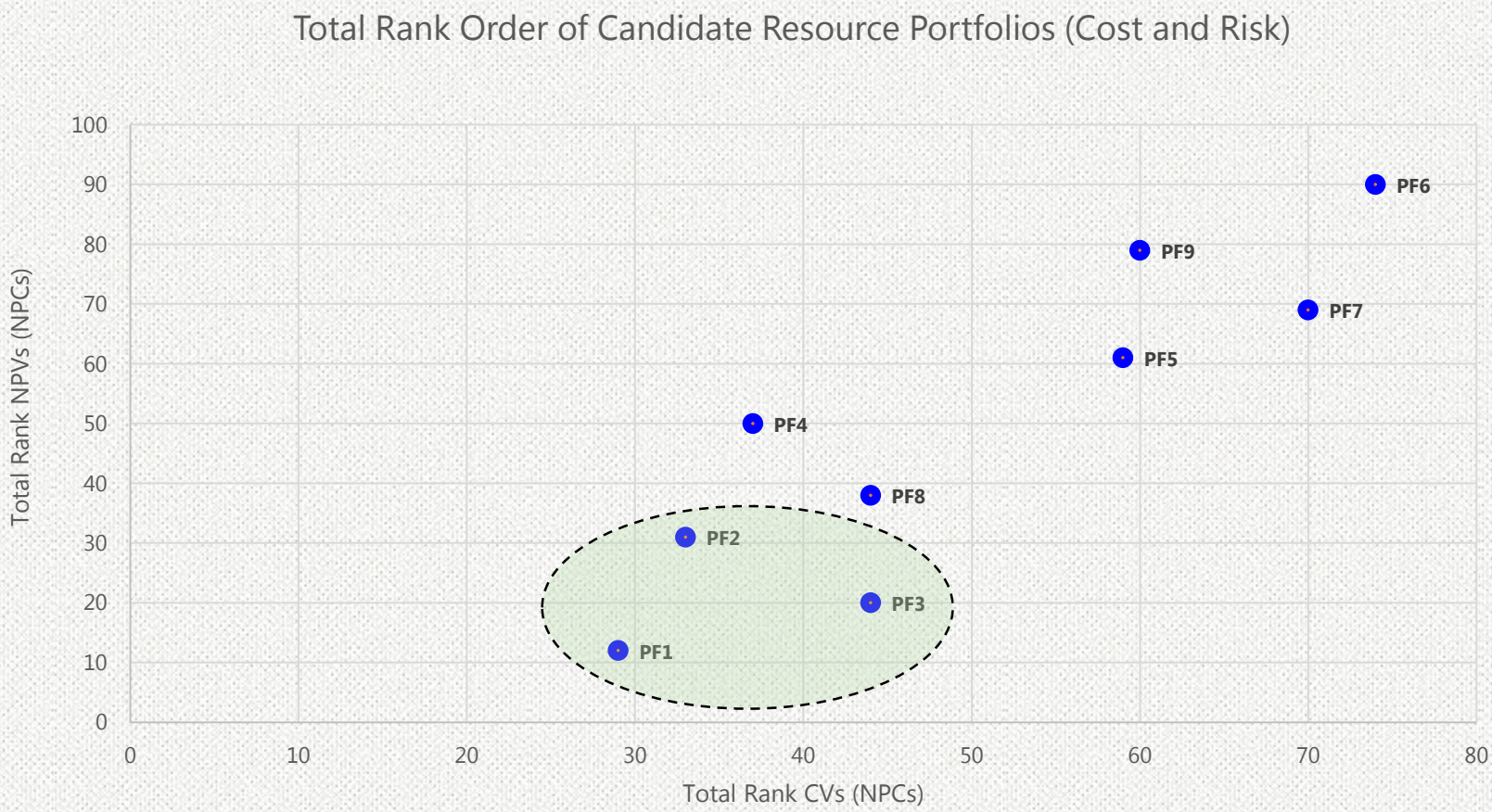
CUMULATIVE RESOURCE ADDITIONS TO EXISTING CITY LIGHT RESOURCE PORTFOLIO (2035)



SCENARIOS FOR STRESS TESTING

Name	Description
Expected	Expected conditions
High Demand	High SCL demand
Low Demand	Low SCL demand
High NG	High natural gas market prices
Low NG	Low natural gas market prices
High CO_2	High CO_2 prices
Base CO_2	Medium CO_2 Prices
Low CO_2	Low CO_2 Prices
High Water	Abundant water conditions
Low Water	Scarce water conditions

OVERALL RANK ORDER OF CANDIDATE PORTFOLIOS



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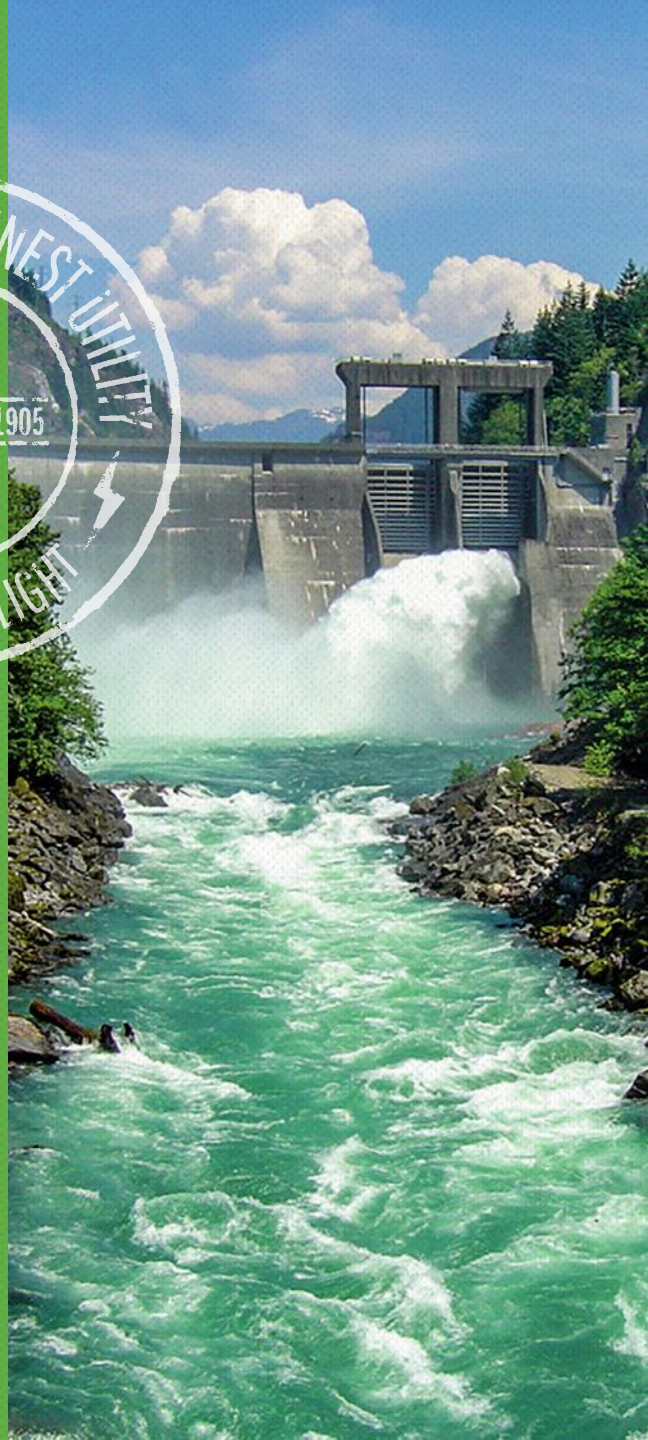


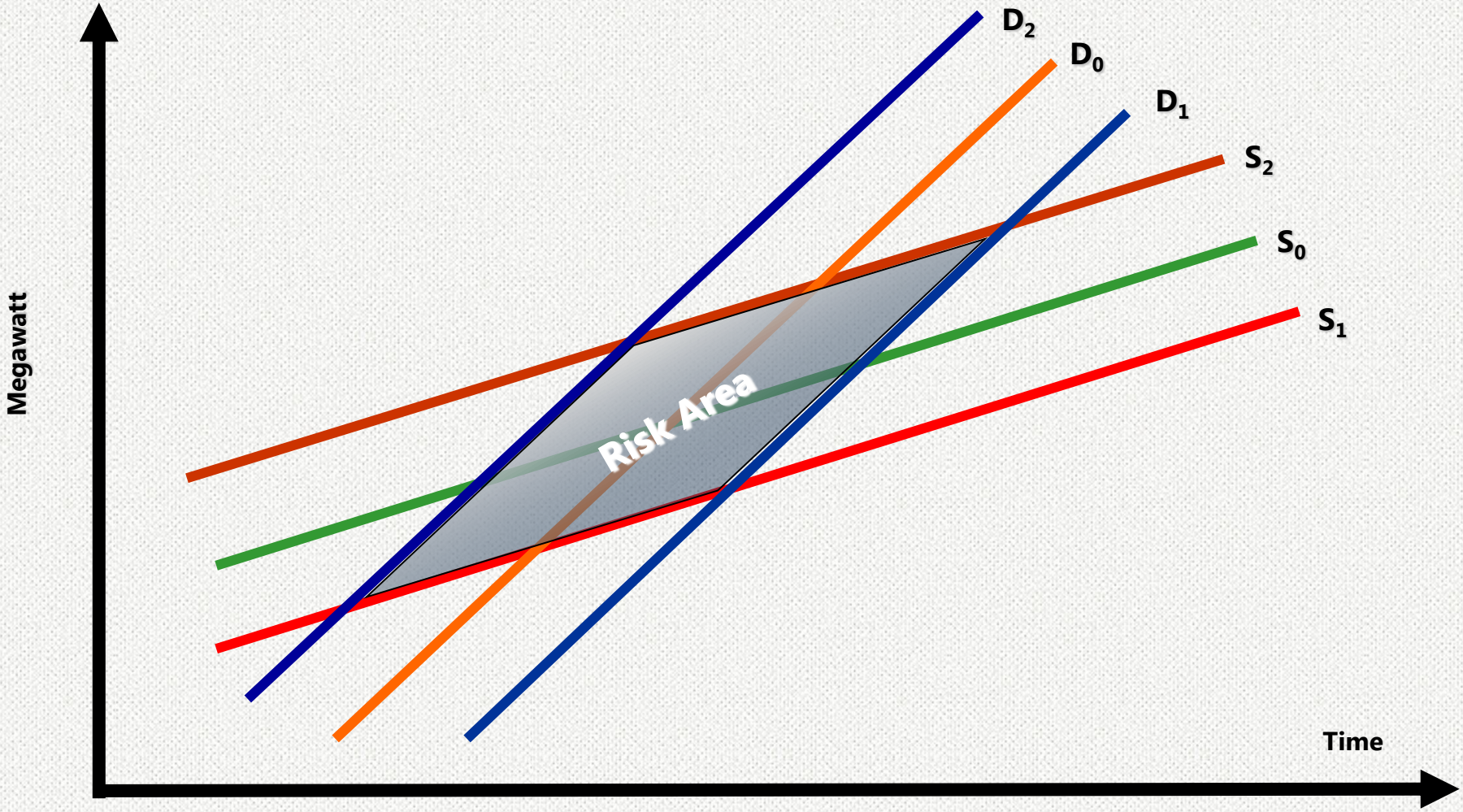
PROBABILISTIC ANALYSIS

Top Performing Portfolios

WHY RISK ANALYSIS?

- Risk analysis is a technique to identify and assess factors that may jeopardize the success of achieving a goal
- City Light's goal is to **reliably** meet customer demand with **cost-effective** and **environmentally friendly** resources

RISK ANALYSIS OF SUPPLY AND DEMAND



RISK FACTORS: DEMAND

Demand (1981-2015)

- Statistical analysis of demand
  - Measures of historical yearly variation were incorporated into the probability distribution analysis
  - Annual demand approximately follows a normal distribution

RISK FACTORS: SUPPLY

Hydro Generation Capability (1990-2015)

- Statistical analyses of generation capabilities of Skagit, Boundary and BPA Hydro Projects (BPA Slice)
  - Measures of historical yearly variations and cross-sectional correlations were incorporated into the probability distribution analysis
  - Annual hydro generation approximately follows a normal distribution

RISK FACTORS: SUPPLY

Natural Gas Prices (1990-2015)

- Statistical analysis of natural gas prices
  - Historical yearly prices of Henry Hub and other correlated gas hubs such as Sumas, Stanfield, Malin, Opal, Topock and AECO were analyzed
  - Measures of historical yearly variation were incorporated into the probability distribution analysis
  - Annual natural gas prices approximately follow a lognormal distribution

FUNCTIONAL FORM OF RISK

$$Risk_{t_i} = \varphi(D_{t_i}, H_{t_i}, F_{t_i})$$

$$t \in \{2016, 2017, \ldots, 2035\}$$

$$i \in \{1, 2, \ldots, 262\}$$

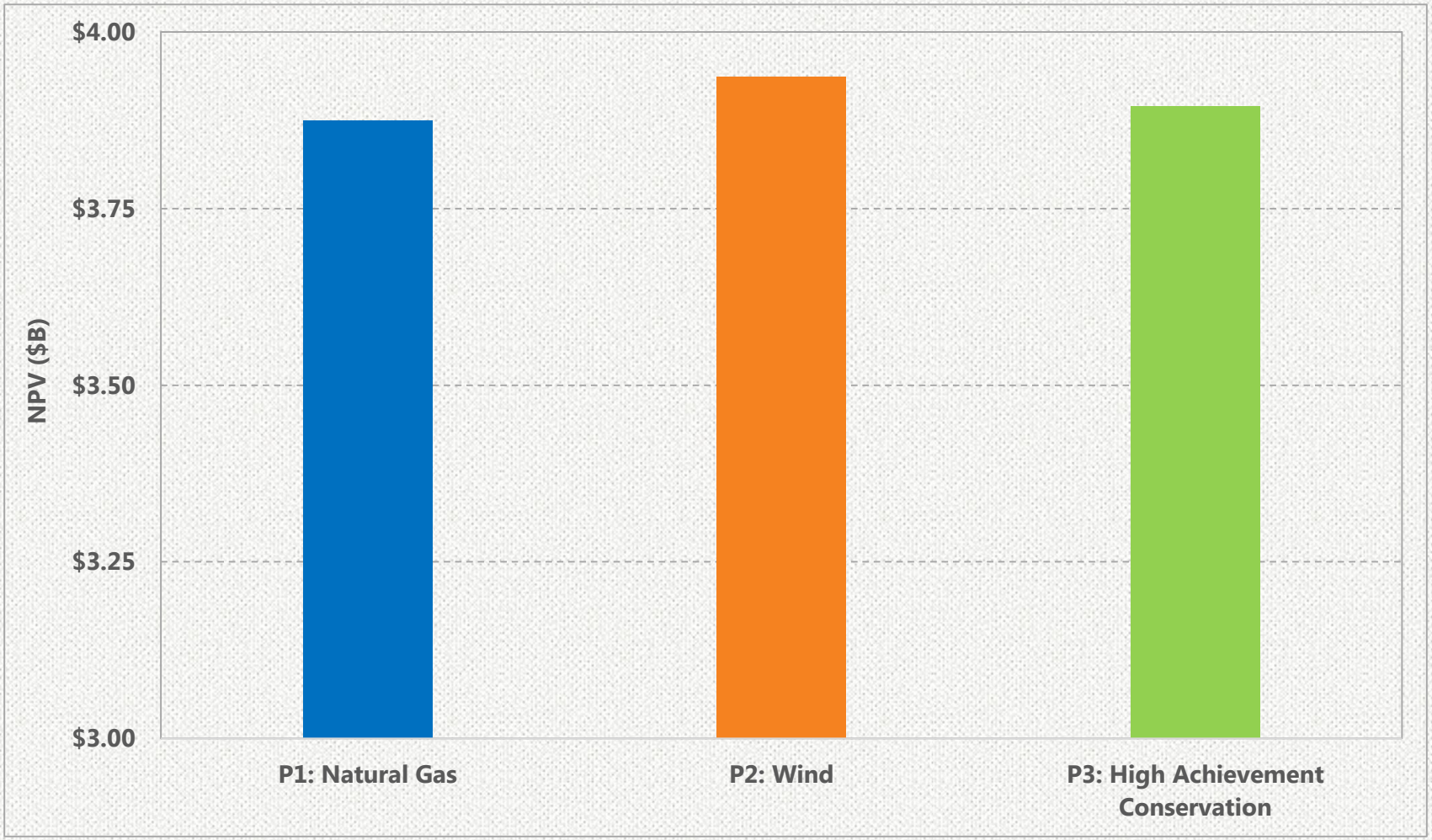
$D = Demand$

$H = Hydro(Skagit, Boundary, BPA\_Hydro(Slice))$

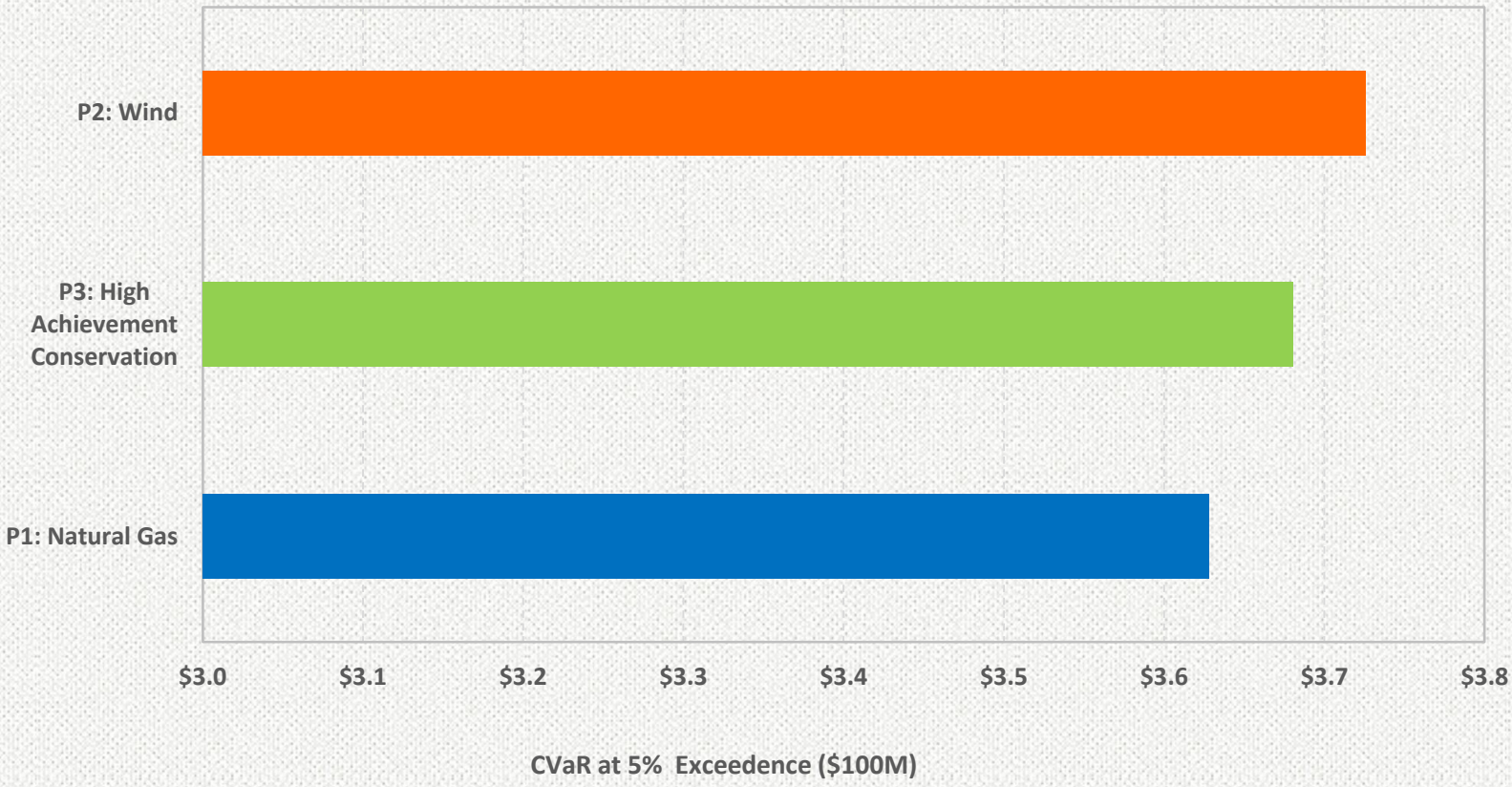
$F = Fuel$

$2882 - Scenarios$

NET POWER COST OF TOP 3 PORTFOLIOS



CONDITIONAL VALUE AT RISK OF TOP 3 PORTFOLIOS



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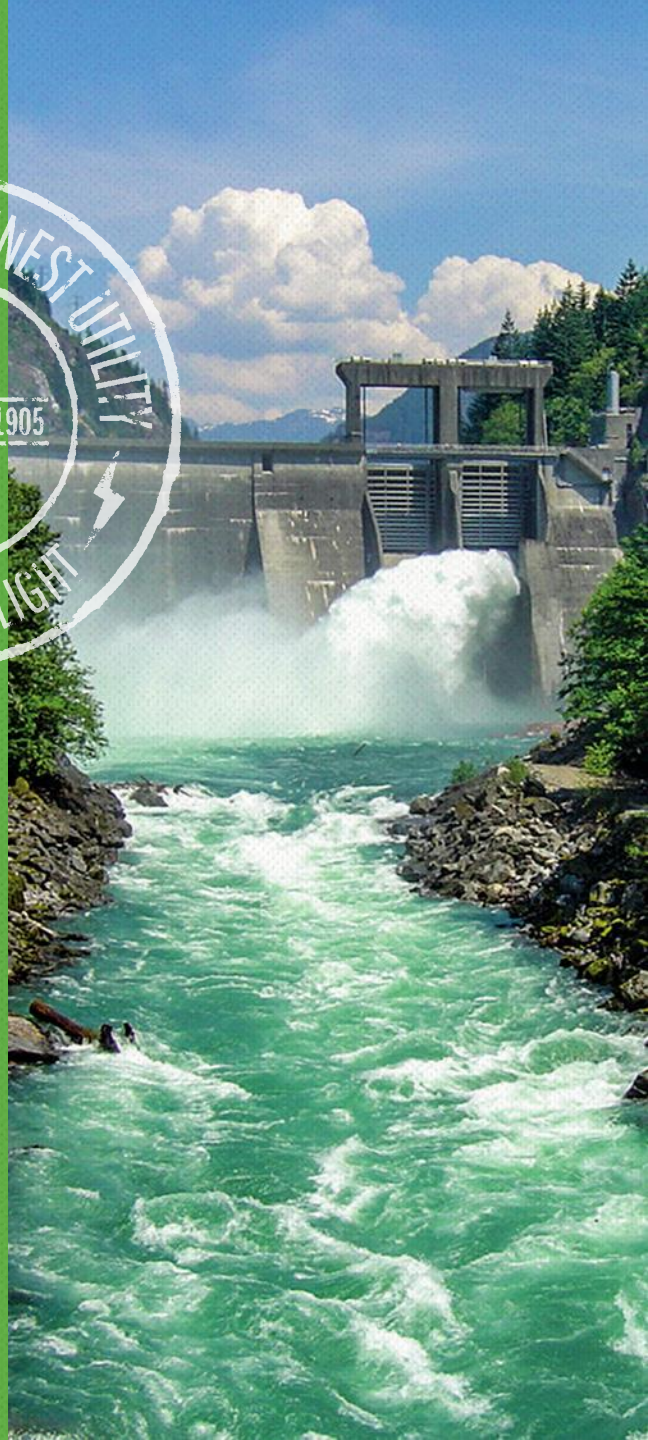
SUMMARY OF TOP PERFORMING PORTFOLIOS AND DRAFT ACTION PLAN



TOP PERFORMING PORTFOLIO SUMMARY

- The three top portfolios perform similarly when considering costs and risks
- P1 has lowest cost and risk but does not meet City Council Resolution (30144)
- P3 performs slightly better than P2 in terms of cost and risk, and it meets City Council Resolution (30144)

DRAFT 2016 IRP RECOMMENDATIONS

Key Actions (DRAFT)	Date
Resource Plan Implementation	
Stakeholder vote on preferred action plan given top-3 performing portfolios based on costs, risks, and environmental impact	Now
Continue to pursue cost-effective programmatic conservation	Ongoing
Continue environmental stewardship	Ongoing
Serve retail load with market purchases, short-term exchanges, and transactions as needed	Ongoing

DRAFT 2016 IRP RECOMMENDATIONS CONTINUED

Key Actions (DRAFT)	Date
Future Resource Costs	
Continue to engage BPA to limit the cost drivers in the FY 2017-18 rate case and beyond	Ongoing
Complete a new conservation resource potential assessment for use by utility and to be in compliance with the Energy Independence Act	Complete future CPA and report in 2018 IRP
Continue to refine forecasts, modeling, and assumptions including technological improvements and climate change impacts	Ongoing

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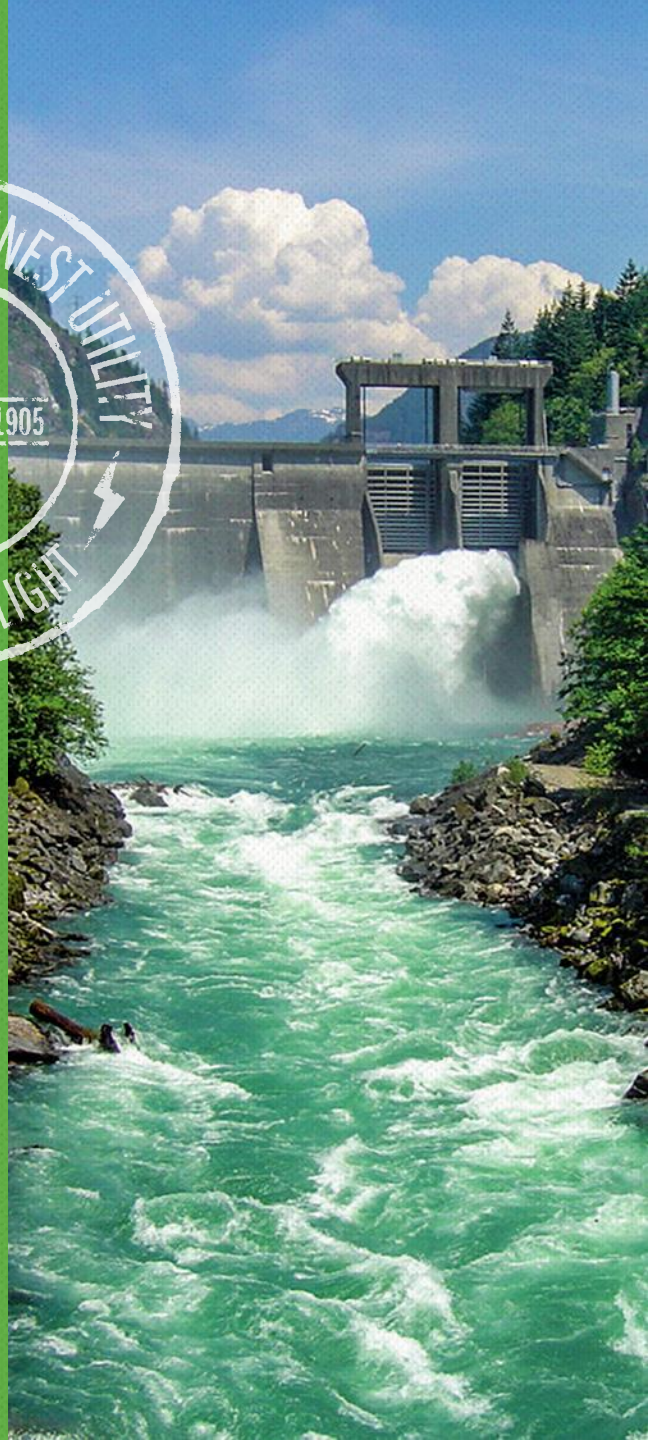
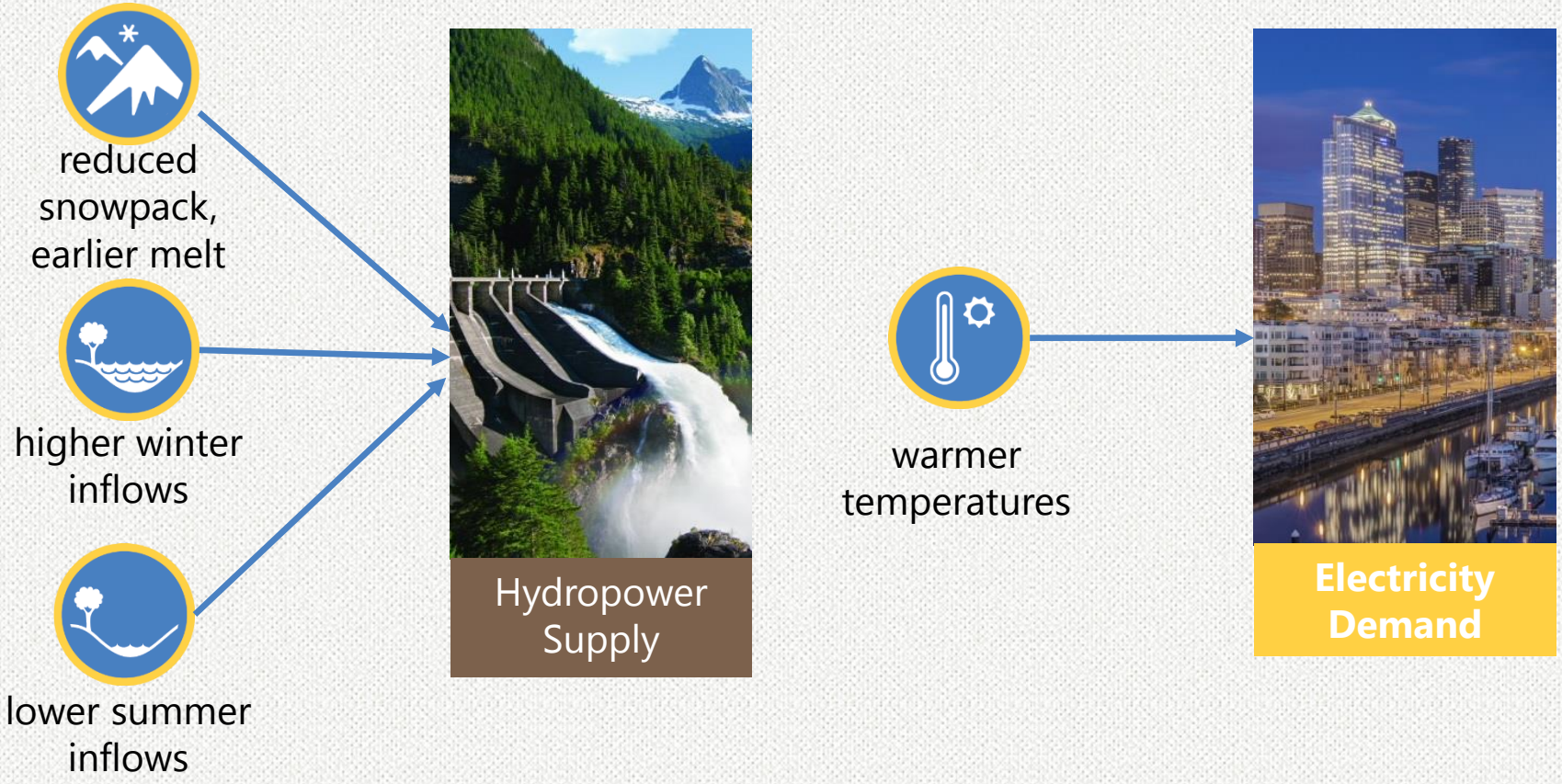
CLIMATE CHANGE IMPACTS ASSESSMENT FIRST PHASE

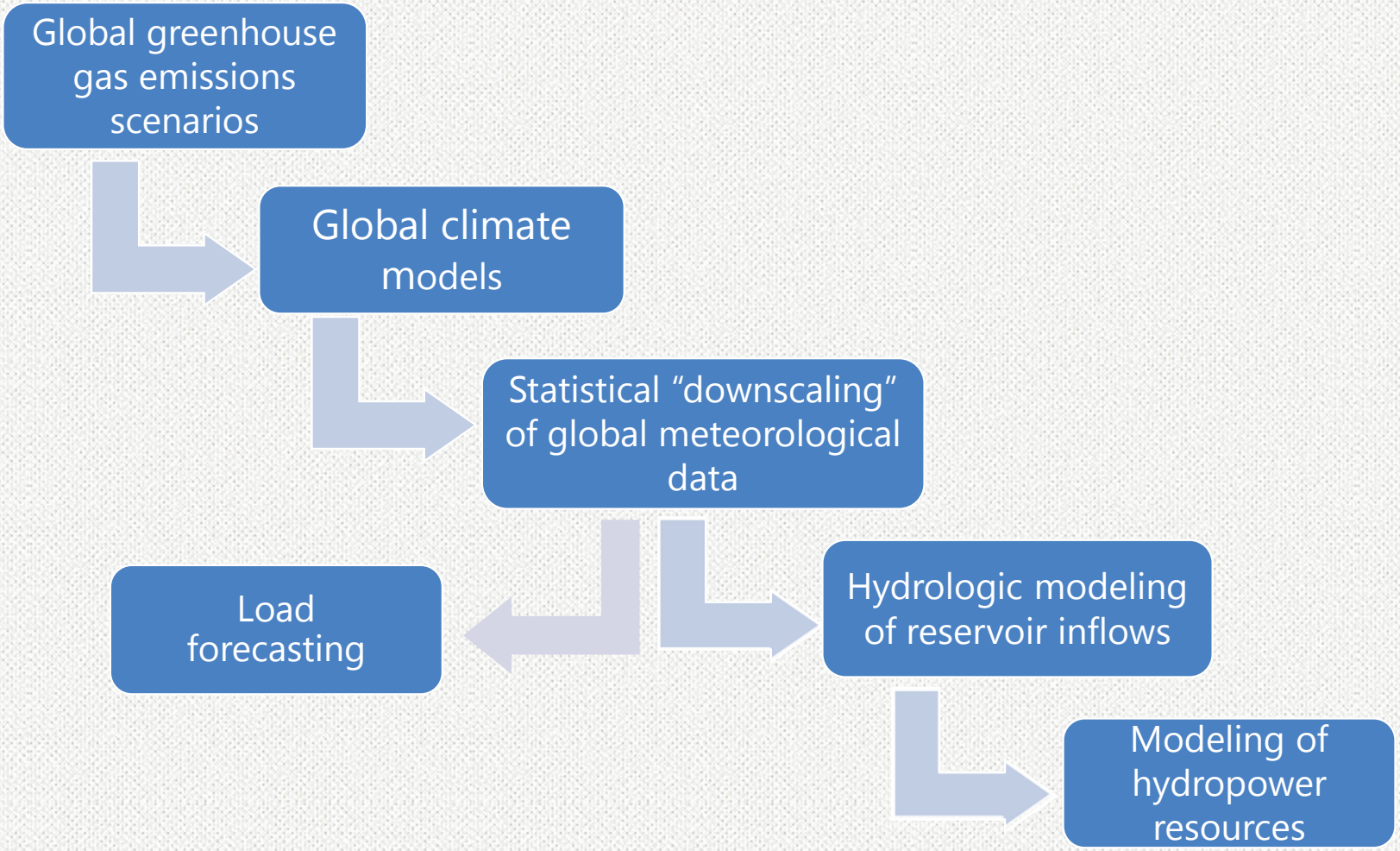


CLIMATE CHANGE ASSESSMENT OVERVIEW

- Used three climate change scenarios to evaluate the impacts of climate change on the expected base model for supply and demand

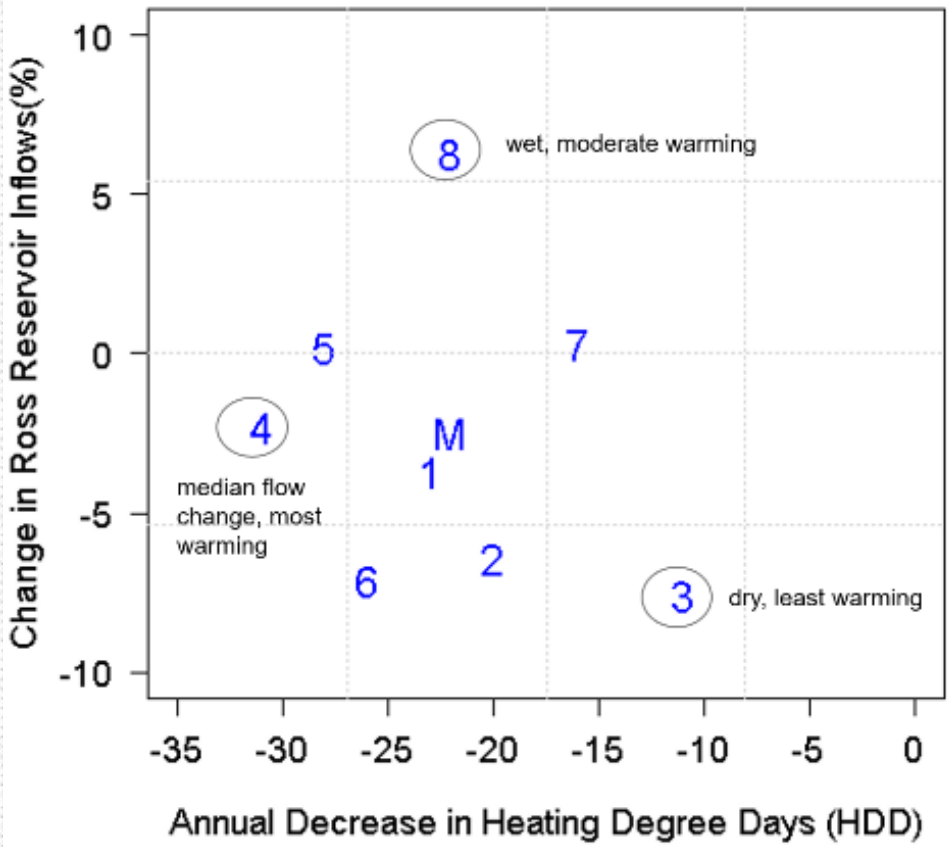


CLIMATE AND HYDROLOGIC MODELING PROCESS



CLIMATE MODEL SELECTION

FIGURE 1. Annual Change: Current vs 2011-2040



Climate Model

1 - CanESM2

2 - CCSM4

3 - CNRM-CM5

4 - HadGEM2-CC

5 - HadGEM2-ES

6 - IPSL-CM5A-MR

7 - MIROC5

8 - NorESM1-M

M – Multi-model Median

CLIMATE CHANGE LOAD FORECAST

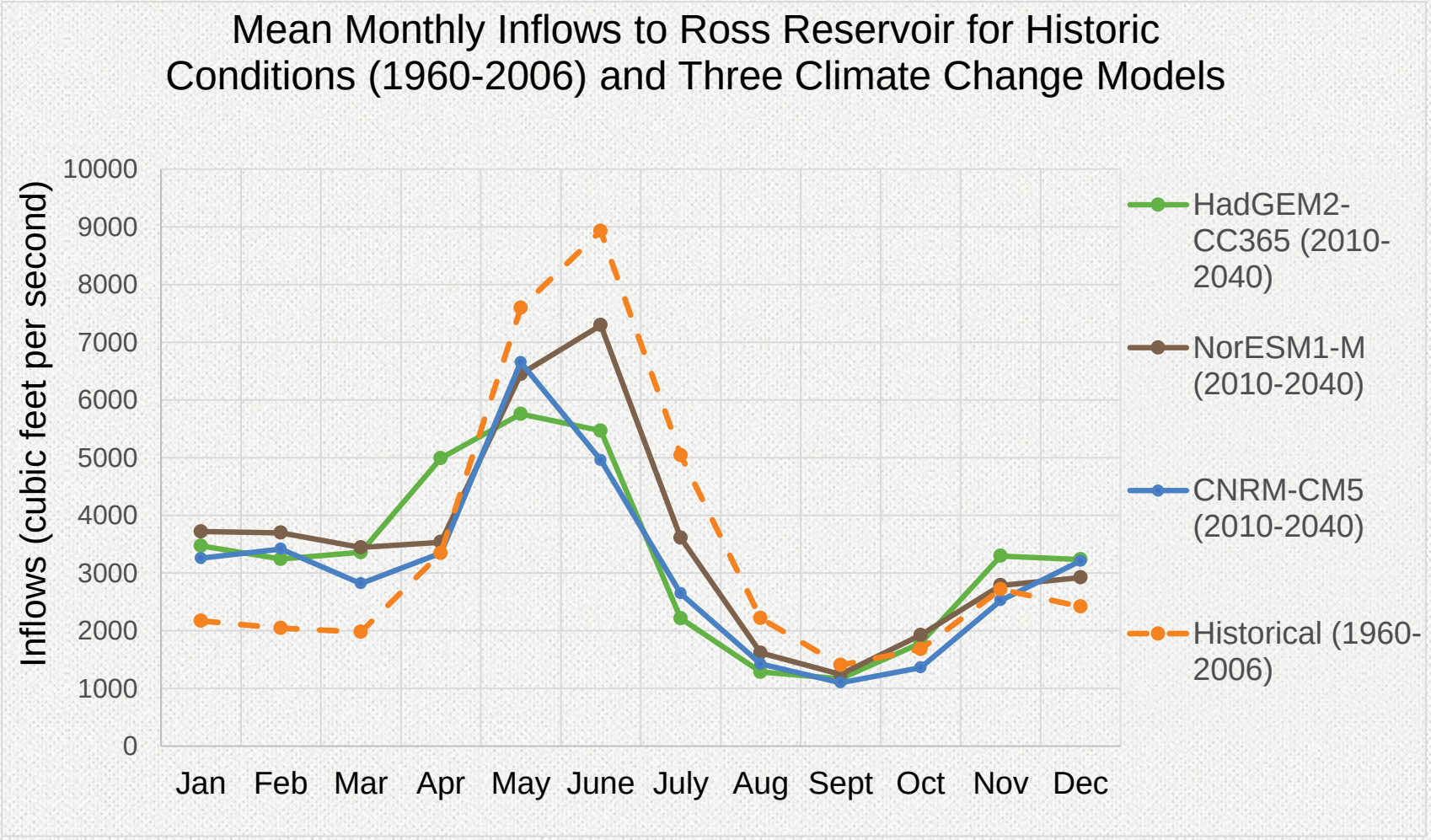
Change in Heating Degree Days in Seattle

Quarter	Current normal	Climate Model		
		HadGEM2-CC	NorESM1-M	CNRM-CM5
1	1899	1798	1848	1868
2	869	770	806	832
3	217	164	168	197
4	1721	1600	1620	1674

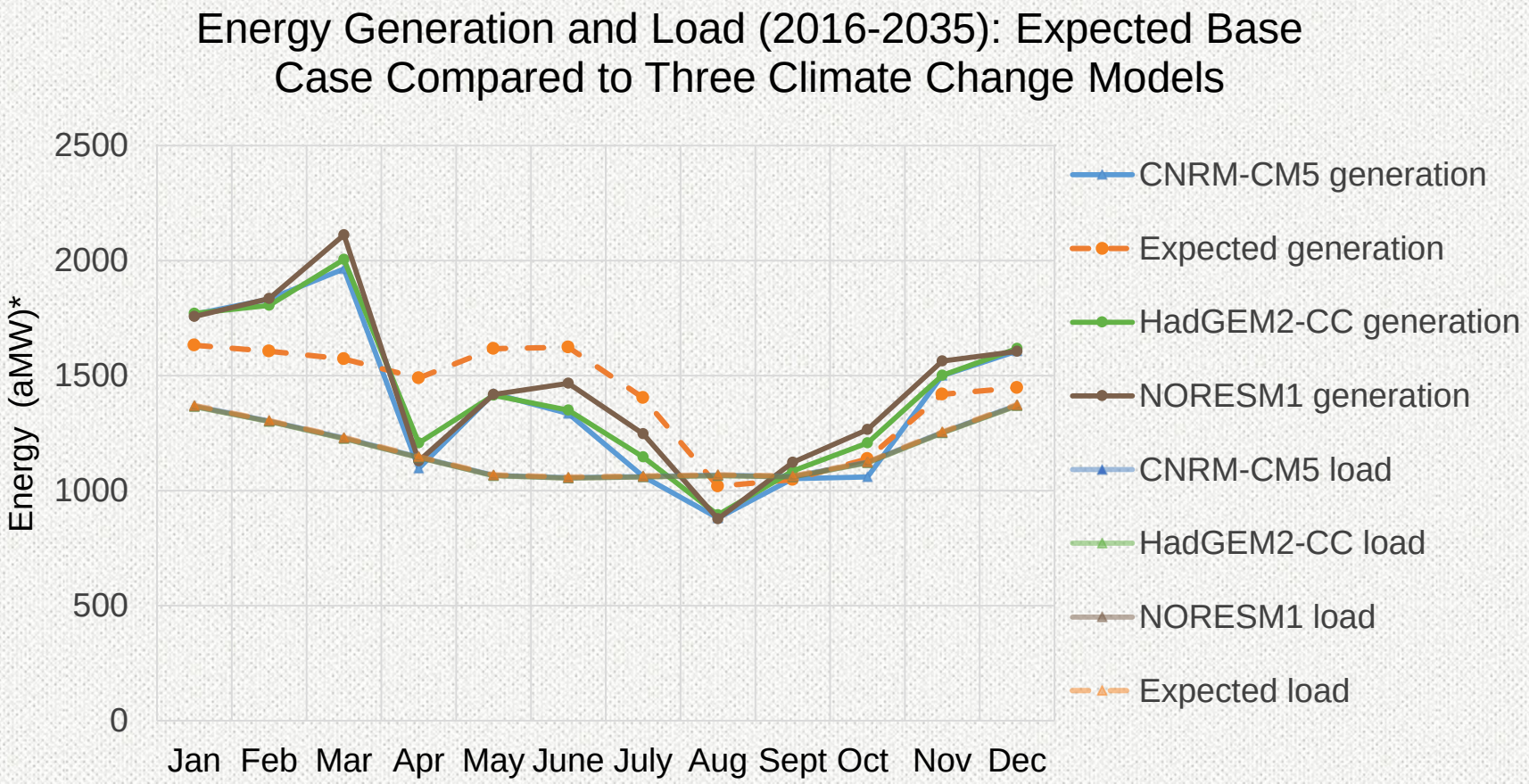
Change in Annual Load Growth Forecast due to Warming

Current normal	Climate Model		
	HadGEM2-CC	NorESM1-M	CNRM-CM5
0.41%	0.37%	0.38%	0.40%

CLIMATE-ALTERED INFLOWS

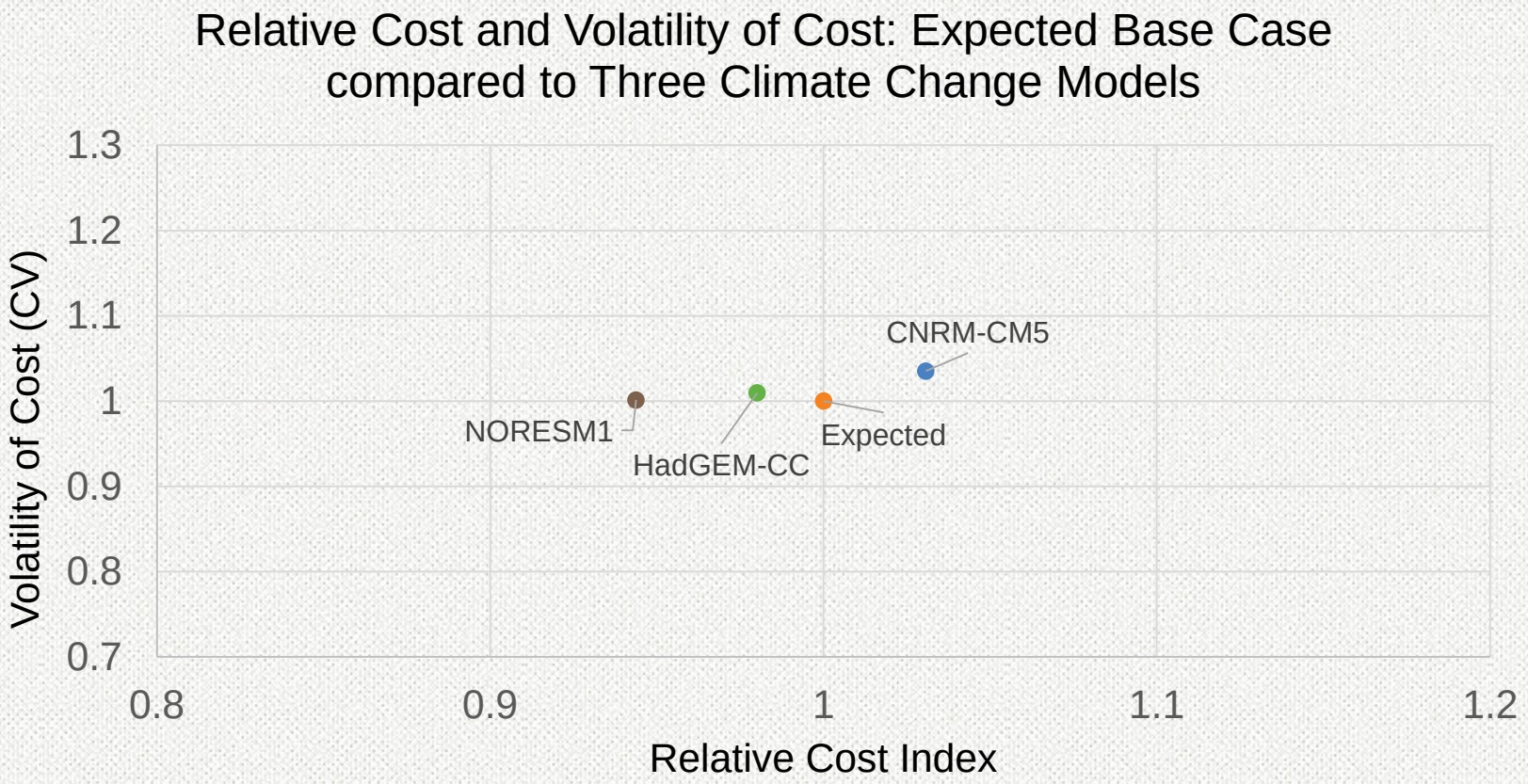


CLIMATE CHANGE SCENARIOS OF HYDROPOWER GENERATION AND LOAD



*Note: Energy excludes new conservation, wholesale market purchases, and replacement contracts for resources other than BPA for the 20-year period.

RELATIVE COST AND COST VOLATILITY



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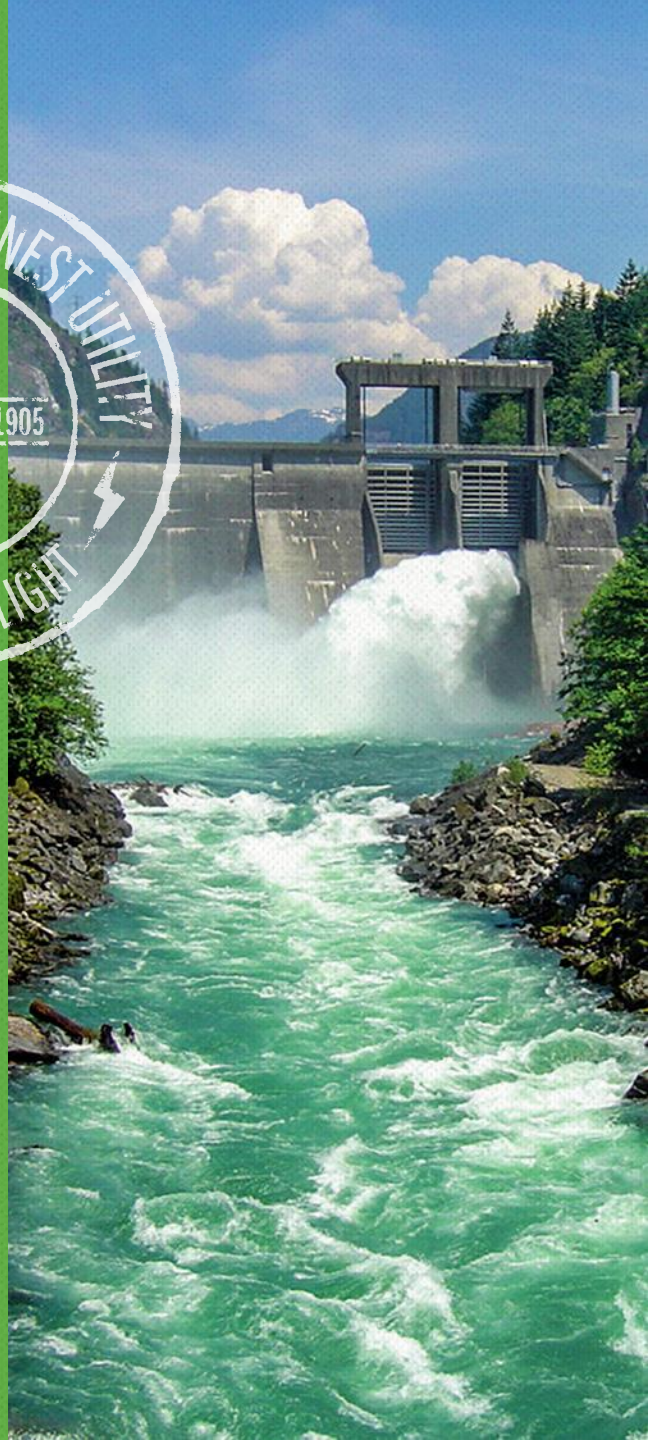
WRAP UP



WRAP UP

- Sign stakeholder support letter for action plan

- Topics for August 4, 2016 stakeholder meeting
  - Feedback about 2016 IRP process
  - Develop work plan for 2018 IRP
  - Discuss Race and Social Justice Initiative and Environmental Equity efforts

Questions or Comments?

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OUR VISION

To set the standard—to deliver the best customer service experience of any utility in the nation.

OUR MISSION

Seattle City Light is dedicated to exceeding our customers' expectations in producing and delivering environmentally responsible, safe, low-cost and reliable power.

OUR VALUES

Excellence, Accountability, Trust and Stewardship.

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